# Short-circuit Isolation

## in Addressable Fire Detection and Alarm Systems

### The requirement for isolation

Analogue addressable fire detection systems are usually designed as loops, with the connecting wires starting and finishing at the fire control panel. Detection devices, manual call points and interfaces are connected at intervals along the cables. Depending on the national or local regulations, audible and visual alarm devices are connected either to the same loop as the detection devices or via dedicated loops. Spurs may be connected at any point of the loop, either directly from the loop wires or from an interface, subject to national or local regulation.

Short-circuits do not occur very often, but when they do, the consequences can be serious, possibly making the affected loop entirely inoperative. It is for this reason that isolators have been designed and incorporated into various devices that are connected to the loop. The purpose of these isolating circuits is to protect the loop in the event of a short or partial short-circuit by disconnecting the part of the loop where the short-circuit has occurred. When the short-circuit fault has been rectified, the isolating circuitry automatically reconnects the affected section of the loop.

### Features of isolating circuits

Isolators are available in different forms:

- As a stand-alone 'isolator' which is fitted onto special detector style 'isolator bases'
- Incorporated into the detector mounting base, known as 'isolating bases'
- Integrated into Apollo devices such as manual call points, audible and visual alarm devices, interfaces or detection devices (see Table 1)

Isolators are intended for use with Apollo systems using XP95®, Discovery® and CoreProtocol®. Isolators are polarity sensitive and switch the negative line of the loop.

Devices including or fitted to isolators remain operative when an adjacent loop section is in the isolated state. The isolated state is normally indicated by a LED illuminated yellow on the device and through the protocol for CoreProtocol systems.

### Equivalent Detector Load

The Equivalent Detector Load (EDL) is a rating value attributed to each device on an XP95/Discovery/CoreProtocol loop, which enables consistent and correct design of the system, when Isolators are used.

Apollo isolating circuits allow the connection of between one and 20 detectors (an EDL of 20) between isolators. The 'equivalent load' for Apollo devices is one for most devices. The 'equivalent load' for devices which are greater than one is given in Table 1. The maximum load for a node is an EDL of 20, this is calculated by adding up the EDL for all devices fitted between two isolators.

### Operating principles

Under normal operating conditions the isolator provides a low resistance in either direction. If the loop voltage falls to a pre-set level, the isolator will switch from the closed state to the open state in order to isolate the loop 'in' and 'out' lines.

The isolated section is automatically tested with a test current and is re-connected at a pre-set load resistance value (see Table 2).

### Isolator type

There are three types of isolator used in Apollo products:

- The original circuit known as 20D, has been in use since the introduction of XP95
- The 20I circuit was developed in order to reduce the test current which is applied to isolated sections of the loop. It reduces the test current by half.
- The 20C isolator is the latest development which performs much like the 20I isolator but with advanced features that allow additional control of the isolator through Apollo CoreProtocol.

### Fire control panel compatibility

Fire control panels that are certificated by Apollo are also compatible with Apollo isolators.

CoreProtocol enabled control panels are able to send a command to 20C isolators which will set a switch open (isolated) state. When the command is reset the isolator will autonomously revert to a closed switch state if no short-circuit is present. It is not possible for 20C isolators to be remotely switched from an open switch to a closed switch state.

### System design

It is essential that both loop loading and isolator requirements are taken into consideration when designing a fire detection system.

Generally the loop devices are wired in sequence, so the number of devices between isolators should equal an EDL of 20. If a star configuration is used at a node in the system there may be more than one isolator being powered at the same time so 4 EDL should be added to the node for each additional isolator being powered simultaneously.

Apollo offers a software programme with which the loop loading viability of a design can be checked. The LoopCalc programme can be downloaded at www.apollo-fire.co.uk

***Note:*** *All detectors and other devices between any two isolators or isolating devices must be in the same fire zone because communications will be lost if a short circuit occurs between isolators. This design consideration may be subject to national or local regulations.*

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## Quick-start process guide

To work out the isolator loading of a loop:

- Identify the devices between each pair of isolators
- Use Table 1 to determine the EDL of each device

  *Note: If any devices are star connected and include isolators, then add four EDL for each device. Do not include any devices past the isolator in this node.*
- Verify that the sum of the EDL values is less than or equal to 20
- Put the full loop configuration into the ApolloLoopCalc tool
- Verify that the LoopCalc tool confirms 'Loop Design Satisfactory'

## Table1: Apollo products

| Part No. | Product name | Isolator type and EDL value | | | |
|---|---|---|---|---|---|
| | | 20D | 20I | 20C | EDL* |
| | DIN MCP (PCB Assy 43785-378) | | | X | 1 |
| 45681-277, 278 | Integrated Base Sounder 55-91dB (with Isolator) | X | | | 2 |
| 45681-284 | Isolating Base | X | | | 0 |
| 45681-286 | Marine Isolating Base | X | | | 0 |
| 45681-321 | Isolating Base | X** | | | 0 |
| 45681-330 | Sounder Visual Indicator Base 55-91dB (with isolator) | | X | | 1 |
| 45681-333 | Visual Indicator Base (with Isolator) | | X | | 1 |
| 45681-393 | Discovery Sounder Visual Indicator Base (with isolator) | | X | | 1 |
| 45681-394 | Marine Sounder VID Base | | X | | 1 |
| 45681-518 | Deep Isolator Base used with 55000-001/-005/-009 | | X | | 0 |
| 45681-700 | Discovery Sounder VAD Base (Cat O) | | X | | 1 |
| 45681-702 | Discovery Sounder Base (with isolator) | | X | | 1 |
| 45681-705 | Sounder VAD Base (Cat O) | | X | | 1 |
| 55000-001 | Intelligent Open-area Sounder | | X | | 1 |
| 55000-005 | Intelligent Open-area Sounder Visual Indicator | | X | | 1 |
| 55000-009 | Intelligent Open-area Visual Indicator | | X | | 1 |
| 55000-022/023/024 | XP95 Base Mounted Flame Detector | | | | 9 |
| 55000-182 | XP95 Sounder Control Unit – DIN-rail | | | | 3 |
| 55000-265 | XP95 Beam Detector Receiver and Interface | | | | 20 |
| 55000-266 | XP95A Beam Detector Receiver and Interface | | | | 20 |
| 55000-268 | Intelligent Reflective Beam Detector (with isolator) | X | | | 10 |
| 55000-268 | Intelligent Reflective Beam Detector | | | | 10 |
| 55000-280/295 | XP95 Flame Detector | | | | 20 |
| 55000-291/292 | Multi-tone Open-area Sounder/Visual Indicator | | | | 2 |
| 55000-278/279 | Multi-tone Open-area Sounder | | | | 2 |
| 55000-274/275 | Weatherproof Multi-tone Open-area Sounder | | | | 2 |
| 55000-293/294 | Multi-tone Open-area Sounder/Visual Indicator with Isolator | X | | | 2 |
| 55000-296/297 | Weatherproof Multi-tone Open-area Sounder/Visual Indicator | | | | 2 |
| 55000-298/299 | Weatherproof Multi-tone Open-area Sounder/Visual Indicator with Isolator | | X | | 2 |
| 55000-588 | XP95 Input/Output Unit - 3 Channel (with Isolator) | X | | | 7 |
| 55000-709 | VAD Base (Cat O) | | | | 2 |
| 55000-720 | Plug in Isolator | X | | | 0 |

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|---|---|---|---|---|---|
| Part No. | Product name | Isolator type and EDL value | | | |
| | | 20D | 20I | 20C | EDL* |
| 55000-721 | Marine Plug in Isolator | X | | | 0 |
| 55000-740/743 | Loop-powered VAD (Cat C - 15m) *(must be fitted to an Isolating Base)* *** | | | | 20 |
| 55000-741/744 | Loop-powered VAD (Cat W – 6 m) *(must be fitted to an Isolating Base)* | | | | 20 |
| 55000-742/745 | Loop-powered VAD (Cat C - 8.5 m) *(must be fitted to an Isolating Base)* | | | | 20 |
| 55000-750 | Plug in Isolator (up to Q1 2019) | X** | | | 0 |
| 55000-750 | Plug in Isolator (from Q1 2019) | X | | | 0 |
| 55000-760, 765 | XP95 Mini Switch Monitor | | X | | 1 |
| 55000-770 | Marine DIN Rail Dual Isolator | X | | | 0 |
| 55000-773 | Marine DIN Rail Zone Monitor Unit | X** | | | 3 |
| 55000-775 | Marine Mini Switch Monitor | | X | | 1 |
| 55000-797 | XP95 Mains Input/Output Unit – DIN-rail | | | | 4 |
| 55000-802 | DIN Rail Dual Isolator | X | | | 0 |
| 55000-803 | XP95 Input/Output Unit – DIN-rail | | | | 4 |
| 55000-804 | XP95 Output Unit – DIN -rail | | | | 3 |
| 55000-809 | XP95 Switch Monitor Plus | | | | 3 |
| 55000-810 | XP95 Switch Monitor | | | | 3 |
| 55000-812 | DIN Rail ZMU | X** | | | 3 |
| 55000-813 | XP95 Zone Monitor | | | | 3 |
| 55000-818 | XP95 Input/Output Unit | | | | 4 |
| 55000-819 | XP95 Output Unit | | | | 3 |
| 55000-820 | XP95A Switch Monitor Input/Output Unit | | | | 4 |
| 55000-821 | XP95 Switch Monitor Plus – DIN-rail | | | | 3 |
| 55000-822 | XP95 Switch Monitor – DIN rail | | | | 3 |
| 55000-823 | XP95 Sounder Control Unit | | | | 3 |
| 55000-825 | XP95A Sounder Control Module | | | | 3 |
| 55000-832 | XP95 Mini Switch Monitor with interrupt | | | | 3 |
| 55000-833 | XP95 Mini Switch Monitor | | | | 1 |
| 55000-841 | XP95 Switch Monitor Plus (with Isolator) | X | | | 3 |
| 55000-843 | XP95 Switch Monitor (with Isolator) | X | | | 3 |
| 55000-845 | XP95 Zone Monitor (with Isolator) | X | | | 3 |
| 55000-847 | XP95 Input/Output Unit (with Isolator) | X | | | 4 |
| 55000-849 | XP95 Output Unit (with Isolator) | X | | | 3 |
| 55000-852 | XP95 Sounder Control Unit (with Isolator) | X | | | 3 |
| 55000-875 | XP95 Input/Output Unit – Mains switching | | | | 4 |
| 55100-9XX | XP95 Manual Call Point (with Isolator) - various housings | | X | | 1 |
| 58000-005/007 | Discovery Open-area Sounder Visual Indicator (with Isolator) | | X | | 1 |
| 58000-010/020 | Discovery Open-area Voice Sounder (with isolator) | | X | | 1 |
| 58000-030 | Discovery Open-area Voice Sounder Visual Indicator (with isolator) | | X | | 1 |
| 58100-971 | Discovery Marine MCP with Isolator | | X | | 1 |
| 58100-976 | Discovery Waterproof Marine MCP with Isolator | | X | | 1 |
| 58100-9XX | Discovery Manual Call Point (with Isolator) - various housings | | X | | 1 |
| 58200-976 | Discovery Waterproof Marine MCP with Isolator | | X | | 1 |
| FL5100-600 | Soteria Dimension Optical Detector | | | X | 1 |
| FL6100-600 | Soteria Dimension Specialist Optical Detector | | | X | 1 |
| SA4700-100 | Intelligent Switch Monitor | | | X | 1 |

***55000-740/743 Loop-powered VAD (Cat C-15m) - **Special Instructions:** *Product requires a specialist installation method, please purchase kit - 55000-747APO (C-3-15, red body) or 55000-748APO (C-3-15, white body) and refer to IG:39215-365 for further information.*

| Table1: Apollo products | | | | | |
|---|---|---|---|---|---|
| Part No. | Product name | Isolator type and EDL value | | | |
| | | 20D | 20I | 20C | EDL* |
| SA4700-102 | Intelligent Input/Output Unit | | | X | 1 |
| SA4700-103 | Intelligent Mains Input/Output Unit | | | X | 2 |
| SA4700-300 | Intelligent Switch Monitor - DIN Rail | | | X | 1 |
| SA4700-302 | Intelligent Input/Output Unit - DIN-rail | | | X | 1 |
| SA4700-403 | Intelligent Mains Input/Output Unit - DIN-rail | | | X | 2 |
| SA5100-400 | Soteria Heat Detector (with Isolator) | | | X | 1 |
| SA5150-450 | Soteria UL Heat Detector | | | X | 1 |
| SA5150-650 | Soteria UL Photoelectric Smoke Detector | | | X | 1 |
| SA5150-750 | Soteria UL Multi-Criteria Detector (Photoelectric/Heat) | | | X | 1 |
| SA5100-600 | Soteria Optical Detector (with Isolator) | | | X | 1 |
| SA5100-700 | Soteria Multi-Sensor Detector (with Isolator) | | | X | 1 |
| SA5900-908 | Intelligent Manual Call Point with Isolator | | | X | 1 |
| SA5900-928 | Marine Intelligent MCP | | | X | 1 |
| SA7100-100 | Intelligent Reflective Beam Detector | | | X | 10 |
| XPA-IN-14007-APO | XPander Loop Interface | | X | | 2 |

*EDL* - Equivalent Detector Load*
*X** - Early version of the 20D isolator with similar characteristics*

| Table 2: EN 54-17 parameters | | | | |
|---|---|---|---|---|
| EN 54-17 parameter | Description | Isolator type | | |
| | | 20D | 20I | 20C |
| $V_{min}$ | Loop dc voltage | 17 V | 17 V | 17 v |
| $V_{max}$ | Loop dc voltage + Pulse V | 28 V + 9 V | 28 V + 9 V | 35 V + 13 V |
| $V_{SO\ max}$ | Isolation voltage | 14.8 V | 14.8 V | 15 V |
| $V_{SO\ min}$ | Isolation voltage | 13.6 V | 13.6 V | 12.5 V |
| $V_{SC\ min}$ | Voltage to de-isolate (on isolated section with test current applied) | 12.9 V | 12.9 V | 12.8 V |
| $V_{SC\ max}$ | Voltage to de-isolate (on isolated section with test current applied) | 18 V | 18 V | 19.1 V |
| $I_{C\ max}$ | Continuous switch current | 1 A | 1 A | 1 A |
| $I_{S\ max}$ | Maximum switch current | 3 A | 3 A | 3 A |
| $I_{L\ max\ dc}$ | Maximum Isolator leakage current (Test Current) | 50mA (pulsed) | 28.2mA (dc) | 33mA (pulsed) |
| $Z_{C\ max}$ | Maximum series resistance - switch closed | 0.2Ω | 0.2Ω | 0.1Ω |